

Main Roads Technical Standard

MRTS05

Unbound Pavements

TRADEMARKS ACKNOWLEDGEMENT

Terms mentioned in this document that are known or understood to be trademarks, whether registered or not, have been identified. Where trademarks have been confirmed as registered in Australia, this has been indicated by the addition of the ® symbol, otherwise the ™ symbol is used. While all care has been taken to identify trademarks, users should rely on their own inquiries to determine trademark ownership. Use of a term in this document as a trademark should not be regarded as affecting the validity of any trademark.

IMPORTANT INFORMATION

The requirements of this document represent Technical Policy of the department and contain Technical Standards. Compliance with the department's Technical Standards is mandatory for all applications for the design, construction, maintenance and operation of road transport infrastructure in Queensland by or on behalf of the State of Queensland.

This document will be reviewed from time to time as the need arises and in response to improvement suggestions by users. Please send your comments and suggestions to the feedback email given below.

FEEDBACK

Your feedback is welcomed. Please send to mr.techdocs@tmr.qld.gov.au.

DISCLAIMER

This publication has been created for use in the design, construction, maintenance and operation of road transport infrastructure in Queensland by or on behalf of the State of Queensland.

Where the publication is used in other than the department's infrastructure projects, the State of Queensland and the department gives no warranties as to the completeness, accuracy or adequacy of the publication or any parts of it and accepts no responsibility or liability upon any basis whatever for anything contained in or omitted from the publication or for the consequences of the use or misuse of the publication or any parts of it.

If the publication or any part of it forms part of a written contract between the State of Queensland and a contractor, this disclaimer applies subject to the express terms of that contract.

COPYRIGHT

Copyright protects this publication. Except for the purposes permitted by and subject to the conditions prescribed under the Copyright Act, reproduction by any means (including electronic, mechanical, photocopying, microcopying or otherwise) is prohibited without the prior written permission of the department. Enquiries regarding such permission should be directed to the Contracts and Technical Capability Branch, Queensland Department of Transport and Main Roads.

© State of Queensland (Department of Transport and Main Roads) 2011



<http://creativecommons.org/licences/by-nc-nd/2.5/au>

Table of Contents

	Page
1 INTRODUCTION.....	1
2 DEFINITION OF TERMS	1
3 REFERENCED DOCUMENTS	2
4 STANDARD TEST METHODS	2
5 QUALITY SYSTEM REQUIREMENTS.....	3
5.1 Hold Points, Witness Points and Milestones.....	3
5.2 Construction Procedures.....	3
5.3 Lots.....	3
5.4 Conformance Requirements	3
5.5 Testing Frequencies	3
6 QUARRY ASSESSMENT AND CERTIFICATION.....	3
7 MATERIAL	4
7.1 Type 1 Unbound Material	4
7.1.1 General	4
7.1.2 Coarse Component.....	4
7.1.3 Fines Component	4
7.1.4 Particle Size Distribution (Grading).....	5
7.2 Type 2 Unbound Material	5
7.2.1 General	5
7.2.2 Coarse Component.....	6
7.2.3 Fines Component	6
7.2.4 Particle Size Distribution (Grading).....	7
7.2.5 California Bearing Ratio.....	8
7.3 Type 3 Unbound Material	8
7.3.1 General	8
7.3.2 Coarse Component.....	9
7.3.3 Fines Component	9
7.3.4 Particle Size Distribution (Grading).....	10
7.3.5 California Bearing Ratio.....	11
7.4 Type 4 Unbound Material	11
7.5 All Unbound Materials	11
7.6 Stockpiling of Materials.....	11
8 MATERIAL COMPLIANCE TESTING.....	11
8.1 General.....	11
8.2 Testing Frequencies and Number of Tests	12
8.3 Testing.....	12
8.3.1 General	12
8.3.2 Ten Percent Fines Value (Wet) and Wet/Dry Strength Variation	12
8.3.3 Flakiness Index.....	12
8.3.4 California Bearing Ratio.....	12
9 CONSTRUCTION	12
9.1 Process Requirements	12
9.1.1 Layer Thicknesses.....	12
9.1.2 Moisture Content	12
9.1.3 Surface Finish.....	13
9.1.4 Construction Equipment	13
9.2 Product Standards.....	13
9.2.1 Compaction Standard	13
9.2.2 Segregation.....	13
9.2.3 Geometrics, General.....	13
9.2.4 Geometrics, Horizontal Tolerances	14
9.2.5 Geometrics, Vertical Tolerances.....	14

10	CONSTRUCTION COMPLIANCE TESTING	15
10.1	Process Requirements	15
10.1.1	General	15
10.1.2	Pavement Material	15
10.1.3	Moisture Content of the Pavement	15
10.2	Product Requirements.....	15
10.2.1	General	15
10.2.2	Testing Frequencies and Number of Tests.....	15
10.2.3	Geometrics.....	15
10.2.4	Compaction	15
10.2.5	Segregation.....	16
10.2.6	Degree of Saturation	16
10.2.7	Surface Evenness.....	16
10.2.8	Visible Deflection of Pavement Layers	16
10.2.9	Acceptance	16
11	SUPPLEMENTARY REQUIREMENTS.....	16

Unbound Pavements

1 INTRODUCTION

This Technical Standard applies to the construction of road pavements using unbound material.

This Technical Standard shall be read in conjunction with MRTS01 *Introduction to Technical Standards*, MRTS50 *Specific Quality System Requirements* and other Technical Standards as appropriate.

This Technical Standard forms part of the Main Roads Specifications and Technical Standards Manual.

2 DEFINITION OF TERMS

The terms used in this Standard shall be as defined in Clause 2 of MRTS01 *Introduction to Technical Standards*. Further definitions are as defined in Table 2.

Table 2 – Definition of Terms

Term	Definition
acid igneous rock	As defined in AS 1726. Including Rhyolite, Rhyodacite, Dacite, Tuffs (of same composition), Granite, Adamellite and Granodiorite.
base course	A course or courses principally intended to directly support the traffic loads.
basic igneous rock	As defined in AS 1726. Including Basalt, Dolerite and Gabbro.
coarse component	The fraction of the material which does not pass the AS 0.425 mm sieve.
finer component	The fraction of the material passing the AS 0.425 mm sieve.
intermediate igneous rock	As defined in AS 1726. Including Trachyte, Trachyandesite, Andesite, Tuffs (of same composition), Syenite and Diorite.
material group	A category selected on the basis of material classification, geological processes and material properties. Materials of one group may grade into another in the one quarry site.
metamorphic rock	As defined in AS 1726 including Hornfels, Quartzite, Metagreywacke, Greenstone, Slate and Amphibolite.
natural gravel	Naturally occurring granular alluvial, colluvial or residual deposits.
pavement	The portion of the road placed above the subgrade for the support of and to form a running surface for, vehicular traffic.
pavement verge	The edge section of the pavement as defined above, which may consist of material differing from the remainder of the pavement due to different requirements for the edge section.
quarry	A site from which construction materials are won by blasting, ripping or other excavation means for use in their natural state or after processing such as by crushing, screening or combining with other materials. The term quarry also includes pits.
sedimentary and duricrust rocks	As defined in AS 1726 including Limestone, Mudstone, Arenite, Chert, Silcrete and Dolomite.
subbase course	A course or courses principally intended to distribute to the subgrade the loads from overlying courses.
wearing course	A course which has no structural function but protects the underlying course from wear and the ingress of water. A hot-mixed asphalt course less than 50 mm thick and an open graded hot-mixed asphalt course are classed as wearing courses.

3 REFERENCED DOCUMENTS

Table 3 lists documents referenced in this Technical Standard.

Table 3 – Referenced Documents

Reference	Title
AS 1726	Geotechnical site investigations
EP108	Quarry Assessment and Certification, Main Roads Engineering Policy

4 STANDARD TEST METHODS

The standard test methods given in Table 4 will be used in this standard.

Further details of test numbers and test descriptions are given in Clause 4 of MRTS01 *Introduction to Technical Standards*.

Table 4 – Standard Test Methods

Property to be Tested	Method Number
Relationship between test methods	Q010
Selection of Sampling and Testing Location	Q050
Representative Sampling of Soils, Crushed Rock and Aggregates	Q060
Moisture content	Q102A Q102B Q102C Q102D Q102E Q141A
Particle size distribution	Q103A
Liquid limit	Q104A
Plastic limit and plasticity index	Q105
Linear shrinkage	Q106
Relative dry density	Q142A Q144A Q141B Q140A Q141A
Degree of saturation	Q146
California bearing ratio	Q113A Q113C
Flakiness index	Q201
Ten percent fines value	Q205B
Wet/dry strength variation	Q205C
Degradation factor	Q208B
Crushed particles	Q215

Property to be Tested	Method Number
Surface evenness	Q708A
	Q708B
	Q708C
	Q808D

5 QUALITY SYSTEM REQUIREMENTS

5.1 Hold Points, Witness Points and Milestones

General requirements for Hold Points, Witness Points and Milestones are stated in Clause 5.2 of MRTS01 *Introduction to Technical Standards*.

The Hold Points, Witness Points and Milestones applicable to this standard are summarised in Table 5.1

Table 5.1 – Hold Points, Witness Points and Milestones

Clause	Hold Point	Witness Point	Milestone
6	1. Use of quarry.		Quarry assessment and current certification (7 days).
7.2.4	2. Approval of grading envelope – Type 2.		
7.3.4	3. Approval of grading envelope – Type 3.		
8.2	4. Demonstration of material compliance prior to incorporation into pavement.		
10.2.9	5. Covering a pavement layer.		

5.2 Construction Procedures

The Contractor shall prepare documented procedures for all construction processes as defined in Clause 6 of MRTS50 *Specific Quality System Requirements*.

5.3 Lots

In addition to the any other requirements of the Contract, the maximum size of a lot shall be within the limits given in Clause 1.1 of Annexure MRTS05.1.

5.4 Conformance Requirements

The conformance requirements which apply to lots of unbound pavement covered by this standard are summarised in Clauses 8 and 10.

5.5 Testing Frequencies

The testing frequency requirements shall be as stated in Clause 1.2 of Annexure MRTS05.1.

6 QUARRY ASSESSMENT AND CERTIFICATION

A quarry assessment shall be undertaken and the department's certification obtained (or current certification held) for any quarry from which the coarse component for Type 1, Type 2 (excluding Subtype 2.5) or Type 3 (excluding Subtype 3.5) unbound paving materials are to be supplied.

A quarry assessment shall be undertaken for any material source from which Type 4 (excluding Subtype 4.5) unbound paving material is to be supplied but certification is not required.

The quarry assessment and certification shall be conducted in accordance with Engineering Policy number EP108 "Quarry Assessment and Certification".

Copies of current certificates for Type 1, Type 2 or Type 3 paving materials or the quarry assessment for Type 4 materials shall be forwarded to the Administrator at least 7 working days before material deliveries to the stockpile (or direct to the pavement if a stockpile is not required) are to commence. **Milestone**

Material from a quarry shall not be used until the quarry has been approved by the Administrator.

Hold Point 1

7 MATERIAL

7.1 Type 1 Unbound Material

7.1.1 General

Type 1 material shall be manufactured only from source material from a quarry which has current certification and will produce the coarse component of the final product which complies with the relevant properties in Table 7.1.2.

Imported material shall not be added to the source material without the prior approval of the Administrator [Refer to Hold Point 1].

The material subtypes to be used for various locations under the Contract are given in Clause 9 of Annexure MRTS05.1.

7.1.2 Coarse Component

The coarse component properties for Type 1 materials are given in Table 7.1.2.

Table 7.1.2 – Coarse Component Properties – Type 1

Property	Subtype	Material Group †				
		Acid Igneous	Intermediate Igneous	Basic Igneous	Metamorphic	Sedimentary Duricrust
Ten Percent Fines Value (Wet) (kN) minimum	1.1	130	140	150	140	130
	1.2	95	105	110	105	95
Wet/Dry Strength Variation (%) maximum	1.1	40	35	30	35	40
	1.2	45	40	35	40	45
Degradation factor minimum	1.1	40	45	50	45	-
	1.2	30	35	40	35	-
Crushed particles (%) minimum	1.1	70	70	70	70	70
	1.2	70	70	70	70	70
Flakiness Index General (%) maximum	1.1	35	35	35	35	35
	1.2	35	35	35	35	35

† Naturally occurring gravels are to be classified into a material group on the basis of the lithology of the major granular component.

The following additional requirements shall also apply to the coarse component properties given in Table 7.1.2 –

- for Adamellite source material only (Acid Igneous Group), the minimum Ten Percent Fines Value (Wet) for Subtype 1.1 shall be 115 kN; and
- for Greenstone source material only (Metamorphic Group), if the Greenstone does not comply with the specified maximum Wet/Dry Strength Variation Limits, it may be used provided that its Ten Percent Fines Value (Wet) is at least 60 kN greater than the specified minimum value for the relevant subtype.

7.1.3 Fines Component

The fines component of Type 1 material shall comply with the properties as given in Table 7.1.3.

Requirements for both plasticity index and linear shrinkage are given in Table 7.1.3. Only one of these properties shall apply to each particular subtype. The property for this Contract is given in Clause 10 of Annexure MRTS05.1.

Table 7.1.3 – Fines Component Properties – Type 1

Property	Subtype	
	1.1	1.2
Liquid Limit maximum	25	28
Plasticity Index maximum	4	6
Linear Shrinkage maximum	2.5	3

7.1.4 Particle Size Distribution (Grading)

The particle size distribution requirement is given in Table 7.1.4. The Contractor shall aim at producing material conforming to the target grading. The maximum and minimum limits define an acceptable zone of departure from this target grading for any single sample.

Table 7.1.4 – Particle Size Distribution – Type 1

AS Sieve Size (mm)	Percentage by Mass passing		
	Target	Minimum	Maximum
37.5	100	100	100
26.5	100	85	100
19.0	87	75	100
9.5	69	58	80
4.75	54	45	62
2.36	39	33	45
0.425	18	14	22
0.075	7	5	10

The following additional requirements shall apply to the particle size distribution given in Table 7.1.4 –

- a) the ratio of the percentage of the material passing the AS 0.075 mm sieve and the percentage of the material passing the AS 0.425 mm sieve, calculated to the nearest 0.01, shall lie between 0.30 and 0.55; and
- b) the grading curve of the material shall be smooth and shall not vary from one outer third of the total limits range between the minimum and maximum limits for one sieve to the opposite outer third of the total limits range for the next lower sieve.

7.2 Type 2 Unbound Material

7.2.1 General

Type 2 material, excluding Subtype 2.5, shall comply where applicable with the following requirements –

- a) any component retained on the AS 2.36 mm sieve shall be manufactured only from source material from a quarry which has current certification and will produce the coarse component of the final product which complies with the relevant properties given in Table 7.2.1; and
- b) any component passing the AS 2.36 mm sieve and retained on the AS 0.425 mm sieve (ie sand size) shall be obtained from either a natural deposit in which the individual grains are hard and durable or a crushed rock source which has current certification and from which the coarse component complies with the properties given in Table 7.2.1.

Table 7.2.1 – Coarse Component Properties – Type 2

Property	Subtype	Material Group †				
		Acid Igneous	Intermediate Igneous	Basic Igneous	Metamorphic	Sedimentary Duricrust
Ten Percent Fines Value (Wet) (kN) minimum	2.1	115	125	135	125	115
	2.2	100	105	115	105	100
	2.3	85	90	100	90	85
	2.4	70	80	85	80	70
	2.5	-	-	-	-	-
Wet/Dry Strength Variation (%) maximum	2.1	40	35	30	35	40
	2.2	40	35	30	35	40
	2.3	45	40	35	40	45
	2.4	45	40	35	40	45
	2.5	-	-	-	-	-
Degradation factor minimum	2.1, 2.2	40	45	50	45	40
	2.3, 2.4	30	35	40	35	30
	2.5	-	-	-	-	-
Flakiness Index General (%) maximum	2.1, 2.2	35	35	35	35	35
	2.3, 2.4	40	40	40	40	40
	2.5	-	-	-	-	-

† Naturally occurring gravels are to be classified into a material group on the basis of the lithology of the major granular component.

Material can be imported to overcome grading and plastic property deficiencies provided it complies with the above requirements.

The strength of Type 2 material is principally assessed by the soaked California Bearing Ratio (CBR) test (Test Method Q113A). To comply with the relevant CBR requirement, it may be necessary for the Contractor to develop a set of secondary requirements which comply with the list of primary requirements given in Clauses 7.2.2, 7.2.3 and 7.2.4 but, where necessary, are more stringent so that the specified CBR is achieved.

The material subtypes to be used for various locations under the Contract are given in Clause 9 of Annexure MRTS05.1.

7.2.2 Coarse Component

The coarse component properties for Type 2 material are given in Table 7.2.1.

In addition to the coarse component properties given in Table 7.2.1, for Greenstone source material only (Metamorphic Group), if the Greenstone does not comply with the specified maximum wet/dry variation limits, it may be used provided that its ten percent fines value (wet) is at least 60 kN greater than the specified minimum value for the relevant subtype.

7.2.3 Fines Component

The fines component properties for Type 2 materials are given in Table 7.2.3.

Requirements for both plasticity index and linear shrinkage are given in Table 7.2.3. Only one of these requirements shall apply to each particular subtype and the requirement for this Contract is given in Clause 10 of Annexure MRTS05.1.

Table 7.2.3 – Fines Component Properties – Type 2

Property	Subtype				
	2.1	2.2	2.3	2.4	2.5
Liquid Limit maximum	25	25	28	35	40
Plasticity Index maximum	6	6	8	12	14
Weighted Plasticity Index maximum	150	150	200	360	-
Linear Shrinkage maximum	3.5	3.5	4.5	6.5	7.5
Linear Shrinkage x % of the whole sample passing the AS 0.425 mm sieve maximum	85	85	110	195	-

Requirements for both Weighted Plasticity Index and Linear Shrinkage x % of whole sample passing the AS 0.425 mm sieve are also given in Table 7.2.3. Only one of these shall apply to each particular subtype. The former shall apply if the requirement given in Clause 10 of Annexure MRTS05.1 is for Plasticity Index and the latter if the requirement is for Linear Shrinkage.

Minimum limits for plasticity index or linear shrinkage shall also apply if given in Clause 11 of Annexure MRTS05.1.

7.2.4 Particle Size Distribution (Grading)

The particle size distribution envelopes are specified in Table 7.2.4-A.

The grading envelopes to be used for various locations under the Contract are given in Clause 9 of Annexure MRTS05.1 as a selection from Table 7.2.4-A.

Table 7.2.4-A – Particle Size Distribution Envelopes – Type 2

AS Sieve Size (mm)	Percent Passing by Mass			
	Grading B	Grading C	Grading D	Grading E
75.0	100	100	100	100
53.0	100	100	100	-
37.5	85 – 100	100	100	85 – 100
19.0	55 – 90	80 – 100	100	-
9.5	40 – 70	55 – 90	80 – 100	40 – 100
4.75	28 – 55	40 – 70	55 – 90	-
2.36	20 – 45	30 – 55	40 – 70	20 – 100
0.425	10 – 25	12 – 30	20 – 40	10 – 80
0.075	4 – 15	5 – 20	8 – 25	4 – 30

The required grading envelope shall also be in accordance with the following requirements –

- a) only grading envelopes B or C may be used for material Subtype 2.1;
- b) only grading envelopes B, C or D may be used for material Subtypes 2.2 and 2.3; and
- c) only grading envelopes B, C or D may be used for material Subtypes 2.4 and 2.5 if used in a base or subbase 1 (upper subbase) layer in the pavement.

If more than one grading envelope is given in Clause 9 of Annexure MRTS05.1 for an entry, the Contractor shall notify the Administrator in writing, at least two working days before the commencement of the delivery of the materials to the pavement, which of the alternative grading envelopes will be used [**Refer to Hold Point 1**].

The envelope chosen shall be the only envelope to be used for the particular location until prior approval is obtained from the Administrator for the use of one of the other alternatives in lieu of the original envelope chosen. Such approval shall be obtained at least two working days before the use of the alternative envelope. **Hold Point 2**

The following additional requirements shall apply to the grading envelopes given in Table 7.2.4-A –

- a) the ratio of the percentage of the material passing the AS 0.075 mm sieve to the percentage of the material passing the AS 0.425 mm sieve, calculated to the nearest 0.01, shall lie between the limits given in Table 7.2.4-B; and

Table 7.2.4-B – Ratio 0.075 mm Material to 0.425 mm Material – Type 2

Subtype	Ratio 0.075 to 0.425 mm	
	Minimum	Maximum
2.1	0.30	0.55
2.2, 2.3	0.30	0.65
2.4, 2.5	-	-

- b) for grading envelopes B, C or D, the grading curve for the material shall be smooth and shall not vary from one outer third of the total limits range between the minimum and maximum limits for one sieve to the opposite outer third of the total limits range for the next lower sieve.

7.2.5 California Bearing Ratio

The California Bearing Ratio requirements for Type 2 material are given in Table 7.2.5.

Table 7.2.5 – California Bearing Ratio Requirements – Type 2

Property	Subtype				
	2.1	2.2	2.3	2.4	2.5
CBR (soaked) minimum	80	60	45	35	15

7.3 Type 3 Unbound Material

7.3.1 General

Type 3 material, excluding Subtype 3.5, shall comply where applicable with the following requirements –

- a) any component retained on the AS 2.36 mm sieve shall be manufactured only from source material from a quarry which has current certification and will produce the coarse component of the final product which complies with the relevant properties given in Table 7.3.1; and
- b) any component passing the AS 2.36 mm sieve and retained on the AS 0.425 mm sieve (ie sand size) shall be obtained from either a natural deposit in which the individual grains are hard and durable or a crushed rock source which has current certification and from which the coarse component complies with the properties given in Table 7.3.1.

Table 7.3.1 – Coarse Component Properties – Type 3

Property	Subtype	Material Group †				
		Acid Igneous	Intermediate Igneous	Basic Igneous	Metamorphic	Sedimentary Duricrust
Ten Percent Fines Value (Wet) (kN) minimum	3.1	100	105	115	105	100
	3.2	80	90	95	90	80
	3.3	70	80	85	80	70
	3.4	60	65	70	65	60
	3.5	-	-	-	-	-
Flakiness Index General (%) maximum	3.1-3.2	35	35	35	35	35
	3.3-3.4	40	40	40	40	40
	3.5	-	-	-	-	-

† Naturally occurring gravels are to be classified into a material group on the basis of the lithology of the major granular component.

The strength of Type 3 material is principally assessed by the unsoaked California Bearing Ratio (CBR) test (Test Method Q113A). To comply with the relevant CBR requirement, it may be necessary for the Contractor to develop a set of secondary requirements which comply with the list of primary requirements given in Clauses 7.3.2, 7.3.3 and 7.3.4 but, where necessary, are more stringent so that the specified CBR is achieved.

Material can be imported to overcome grading and plastic property deficiencies provided it complies with the above requirements.

The material subtypes to be used for various locations under the Contract are given in Clause 9 of Annexure MRTS05.1.

7.3.2 Coarse Component

The coarse component properties for Type 3 materials are given in Table 7.3.1.

7.3.3 Fines Component

The fines component properties for Type 3 materials are given in Table 7.3.3.

Requirements for both plasticity index and linear shrinkage are given in Table 7.3.3. Only one of these requirements shall apply to each particular subtype and the requirement for this Contract is given in Clause 10 of Annexure MRTS05.1.

Requirements for both Weighted Plasticity Index and Linear Shrinkage X% of whole sample passing the AS 0.425 mm sieve are also given in Table 7.3.3. Only one of these shall apply to each particular subtype. The former shall apply if the requirement given in Clause 10 of Annexure MRTS05.1 is for Plasticity Index and the latter if the requirement is for Linear Shrinkage.

Table 7.3.3 – Fines Component Properties – Type 3

Property		Subtype				
		3.1	3.2	3.3	3.4	3.5
Liquid Limit	maximum	25	28	35	35	40
Plasticity Index	maximum	6	8	12	12	14
Weighted Plasticity Index	maximum	150	200	360	-	-
Linear Shrinkage	maximum	3.5	4.5	6.5	6.5	7.5
Linear Shrinkage x % of the whole sample passing the AS 0.425 mm sieve	maximum	85	110	195	-	-

Minimum limits for plasticity index or linear shrinkage shall also apply if given in Clause 11 of Annexure MRTS05.1.

7.3.4 Particle Size Distribution (Grading)

The particle size distribution envelopes are given in Table 7.3.4-A.

The grading envelopes to be used for various locations under the Contract are given in Clause 9 of Annexure MRTS05.1 as a selection from Table 7.3.4-A.

Table 7.3.4-A – Particle Size Distribution Envelopes – Type 3

AS Sieve Size (mm)	Percent Passing by Mass			
	Grading B	Grading C	Grading D	Grading E
75.0	100	100	100	100
53.0	100	100	100	-
37.5	85 – 100	100	100	85 – 100
19.0	55 – 90	80 – 100	100	-
9.5	40 – 70	55 – 90	80 – 100	40 – 100
4.75	28 – 55	40 – 70	55 – 90	-
2.36	20 – 45	30 – 55	40 – 70	20 – 100
0.425	10 – 25	12 – 30	20 – 40	10 – 80
0.075	4 – 15	5 – 20	8 – 25	4 – 30

The grading envelope shall also be in accordance with the following requirements –

- a) only grading envelopes B or C may be used for material Subtype 3.1;
- b) only grading envelopes B, C or D may be used for material Subtypes 3.2 or 3.3; and
- c) only grading envelopes B, C or D may be used for material Subtypes 3.4 or 3.5 if these are used in a base or subbase 1 (upper subbase) layer in the pavement.

If more than one grading envelope is given in Clause 9 of Annexure MRTS05.1 for an entry, the Contractor shall notify the Administrator in writing, at least two working days before the commencement of the delivery of the materials to the pavement, which one of the alternative grading envelopes will be used [**Refer to Hold Point 1**].

The envelope chosen shall be the only envelope to be used for the particular location until prior approval is obtained from the Administrator for the use of one of the other alternatives in lieu of the original envelope chosen. Such approval shall be obtained at least two working days before the use of the alternative envelope. [**Hold Point 3**]

The following additional requirements shall apply to the grading envelopes given in Table 7.3.4-A –

- a) the ratio of the percentage of the material passing the AS 0.075 mm sieve and the percentage of the material passing the AS 0.425 mm sieve, calculated to the nearest 0.01, shall lie between the limits given in Table 7.3.4-B; and

Table 7.3.4-B – Ratio 0.075 mm Material to 0.425 mm Material – Type 3

Subtype	Ratio 0.075 to 0.425 mm	
	Minimum	Maximum
3.1	0.35	0.55
3.2, 3.3	0.35	0.65
3.4, 3.5	-	-

- b) for grading envelopes B, C or D, the grading curve for the material shall be smooth and shall not vary from one outer third of the total limits range between the minimum and maximum limits for one sieve to the opposite outer third of the total limits range for the next lower sieve.

7.3.5 California Bearing Ratio

The California Bearing Ratio requirements for Type 3 material are given in Table 7.3.5.

Table 7.3.5 – California Bearing Ratio Requirements – Type 3

Property	Subtype				
	3.1	3.2	3.3	3.4	3.5
CBR (unsoaked) minimum	80	60	45	35	15

7.4 Type 4 Unbound Material

Type 4 material, excluding Subtype 4.5, shall be manufactured from source material for which a quarry assessment has been carried out. certification of the quarry is not required.

Type 4 material is specified by its unsoaked California Bearing Ratio and any additional requirements given in Clause 12.1 of Annexure MRTS05.1.

The California Bearing Ratio requirements are given in Table 7.4.

Table 7.4 – California Bearing Ratio Requirements – Type 4

Property	Subtype				
	4.1	4.2	4.3	4.4	4.5
CBR (unsoaked) minimum	80	60	45	35	15

The moisture content at which the CBR result is to be reported may vary from OMC for Type 4 materials. The relative moisture content for this Contract is given in Clause 12.2 of Annexure MRTS05.1. If no indication is given for a particular material subtype, the CBR shall be reported at the Optimum Moisture Content.

7.5 All Unbound Materials

All pavement material incorporated into the finished pavement shall be free from sticks, organic matter, clay lumps and other deleterious material. Visual inspection of the material during and after placement shall be used to ensure compliance with this clause.

7.6 Stockpiling of Materials

If a position is given in Clause 2 of Annexure MRTS05.1, the stockpile shall be so positioned. If a position is not given in Clause 2 of Annexure MRTS05.1, the stockpile shall be located on clear, even, firm, well-drained ground in a location where it can be clearly identified.

There shall be a separate stockpile for each material with different requirements.

All stockpiles shall be separated from other stockpiles by at least 2 metres.

For the purpose of testing, each individual stockpile lot shall be clearly delineated by one of the following methods –

- a) a separate stockpile shall be formed for each lot; or
- b) material of the same requirements shall be added to a single stockpile incrementally such that a portion representing a lot is added, tested and found to be conforming before the next portion, representing the next lot, is added. Nonconforming lots shall be removed from the stockpile prior to the addition of further portions.

8 MATERIAL COMPLIANCE TESTING

8.1 General

Compliance testing of materials shall be undertaken for each lot. A lot shall include only material of the same subtype.

Unless indicated otherwise in Clause 3 of Annexure MRTS05.1, samples for material compliance testing shall be taken from the stockpile.

Samples for compliance testing shall be selected by random sampling as given in Test Method Q050 or Q060 as appropriate.

8.2 Testing Frequencies and Number of Tests

The Contractor is responsible for carrying out sufficient testing to ensure that the material complies with the standards and requirements of this standard. However, the Contractor's testing program shall be such that lot sizes are not greater than those stated in Clause 5.3 and testing frequencies and number of tests are not less than those stated in Clause 5.5.

The Contractor shall not incorporate materials into the work unless it has demonstrated that the material complies fully with the requirements of this standard. **Hold Point 4**

8.3 Testing

8.3.1 General

The testing of individual samples shall be carried out in accordance with the test methods set out in Table 4.

8.3.2 Ten Percent Fines Value (Wet) and Wet/Dry Strength Variation

The Ten Percent Fines Value (Wet) and the Wet/Dry Strength Variation tests shall both be carried out on the fraction of the coarse component passing the AS 13.2 mm sieve but retained on the AS 9.5 mm sieve.

However, for material which complies with grading envelopes D or E, if sufficient material for the test cannot be obtained from this sieve range, the tests may be carried out on an alternative fraction approved by the Administrator. This will normally be the next most coarse fraction which comprises 10% or more of the material and conforms with one of the component sizes listed in Test Method Q205B.

8.3.3 Flakiness Index

The Flakiness Index Test results (Test Method Q201) shall be reported for the total sample.

8.3.4 California Bearing Ratio

California Bearing Ratio tests shall be undertaken in accordance with Test Method Q113A, for material Type 2 and Type 3 and any Type 4 material for which the result is to be reported at optimum moisture content (refer to Clause 7.4).

For Type 2 and Type 3 materials and Type 4 materials as described in the previous paragraph, the test result shall be reported at the maximum dry density and optimum moisture content as defined by Test Method Q113A.

For other Type 4 materials, the California Bearing Ratio may be determined from one single-point test, in accordance with Test Method Q113C, carried out at the maximum dry density, and the relative moisture content given in Clause 12.2 of Annexure MRTS05.1. The result reported shall be that at the relative moisture content given in Clause 12.2 of Annexure MRTS05.1.

9 CONSTRUCTION

9.1 Process Requirements

9.1.1 Layer Thicknesses

Individual compacted layer thicknesses shall be chosen to suit the construction process and the requirements of the Contract. Compacted layer thicknesses shall not be greater than 250 mm nor less than 75 mm.

9.1.2 Moisture Content

9.1.2.1 Limits

All points in the pavement shall have a moisture content such that the degree of saturation is less than the relevant limit given in Table 9.1.2.1.

Table 9.1.2.1 – Maximum Degree of Saturation

Material Type	Maximum Degree of Saturation (%)
1	65
2	65
3	70
4	70

9.1.2.2 Construction

A section of a pavement may have a moisture content greater than that represented by the relevant degree of saturation limit given in Clause 9.1.2 for the purpose of construction only, provided that the section of pavement is dried back to the requirements of Clause 9.1.2.1 prior to covering with the next layer of pavement or surfacing.

9.1.3 Surface Finish

The final unbound material layer shall have a uniform surface free from loose, segregated and contaminated areas and the coarse particles shall be slightly exposed. If necessary, the surface shall be trimmed, lightly watered, drag-broomed and rolled with an approved roller to achieve the above finish to the approval of the Administrator.

9.1.4 Construction Equipment

Pavements incorporating Type 1 materials shall be constructed using self-propelled spreading machines purpose-built for this work.

Such machines shall have the capacity to either –

- a) place and spread the material directly on the prepared surface to the necessary uncompacted layer depth, width and shape in one pass; or
- b) spread previously placed windrows of material to the necessary uncompacted layer depth, width and shape in one pass.

Other methods of construction may be used in areas where the pavement width is such that the use of such purpose-built machines is impracticable, subject to the approval of the Administrator.

Self-propelled spreading machines shall have the capacity to spread the material in one pass to the necessary uncompacted layer depth over at least half of the pavement or to at least 3 metres, whichever is the lesser.

If specific equipment is stated in Clause 4 of Annexure MRTS05.1, it shall be used in the construction of pavements with Type 2, 3 or 4 materials.

9.2 Product Standards

9.2.1 Compaction Standard

The characteristic value of the RDDs shall not be less than 102% for all Type 1 materials unless specified otherwise in Clause 5 of Annexure MRTS05.1.

The characteristic value of the RDDs shall not be less than 100% for all Type 2, 3 and 4 materials, unless specified otherwise in Clause 5 of Annexure MRTS05.1.

9.2.2 Segregation

Segregation is the uneven distribution of particle sizes. The construction process shall minimise segregation so that the particle size distribution of the material in the pavement shall comply with the particle size distribution requirements in Clause 7 for the relevant subtype.

9.2.3 Geometrics, General

The pavement shall be constructed so as not to depart from the widths, lengths, heights and shapes specified in the Contract by more than the tolerances stated in Clauses 9.2.4 and 9.2.5. The widths and heights for the surface of layers other than the final layer shall be calculated using the widths, heights and

shapes for the completed pavement as described in the Contract and the depth to the surface of the particular layer within the pavement.

9.2.4 Geometrics, Horizontal Tolerances

The horizontal location of any point on the pavement shall not differ from the corresponding point shown in the Contract, or as calculated as specified in Clause 9.2.3, by more than ± 50 mm except for the following situations –

- a) for pavement edges not adjacent to any other section of pavement and not adjacent to any structure or adjoining road, the transverse tolerance shall be - 50 mm, + 250 mm (where the + tolerance is in the direction which increases the width of the pavement);
- b) where alignment of the pavement with an existing pavement or structure is necessary, the new work shall be joined neatly to the existing work in a smooth manner as shown on the Drawings or, if this is not shown, in an approved manner.

9.2.5 Geometrics, Vertical Tolerances

9.2.5.1 Primary Tolerance

A primary tolerance shall apply to the height of any point on the surface of any layer.

The primary tolerance for Type 1 materials shall be ± 15 mm. The primary tolerance for Type 2, 3 and 4 materials is given in Clause 6.1 of Annexure MRTS05.1 as one of the alternatives set out in Table 9.2.5.1.

Table 9.2.5.1 – Primary Tolerance – Types 2, 3 and 4

Alternative	Primary Tolerance (mm)
A	± 15
B	± 25

9.2.5.2 Additional Tolerances

9.2.5.2.1 General

Additional tolerances, as stated in Clauses 9.2.5.2.2 and 9.2.5.2.3, shall apply to lots in the final unbound layer. These tolerances shall also apply to such other layers as stated in Clause 6.2 of Annexure MRTS05.1. Surface evenness as stated in Clause 9.2.5.2.4 shall apply to lots in the final unbound layer.

The Contractor may have to carry out additional work to achieve these additional tolerances. No additional payment will be made by the Principal for such additional work.

9.2.5.2.2 Deviation from a Straight-Edge

The deviation from a 3 metre long straight-edge placed anywhere on the surface of a layer shall not exceed 5 mm for all Type 1 materials, due allowance being made for design shape, where relevant.

For other material types, the deviation from a 3 metre long straight-edge placed anywhere on the surface of a layer shall not exceed the limit stated in Clause 6.3 of Annexure MRTS05.1, which limit shall be one of the alternatives set out in Table 9.2.5.2.2, due allowance being made for design shape where relevant.

Table 9.2.5.2.2 – Deviation from a Straight-Edge

Alternative	Deviation Limit (mm)
C	5
D	8

9.2.5.2.3 Crossfall

The crossfall shall not depart from the corresponding crossfall shown in the Contract by more than 0.5% absolute.

The crossfall shall be measured –

- a) between any two points more than 2 metres apart except where a pavement verge is less than 2 metres wide. For pavement verges less than 2 metres wide, the measurement shall be made between the extreme edges of the pavement verge on each side of the pavement;
- b) transverse to the centre line; and
- c) within the boundaries of a cross-section element which has a constant crossfall.

9.2.5.2.4 Surface Evenness

The surface evenness of the final pavement layer shall be such as to provide a road roughness count rate not exceeding the specified road roughness (R_s) stated in Clause 7 of Annexure MRTS05.1 or where not so stated, not exceeding 60 counts per kilometre.

10 CONSTRUCTION COMPLIANCE TESTING

10.1 Process Requirements

10.1.1 General

The process requirements shall be checked for compliance with the specified requirements during and after the construction operation, as relevant.

Compliance checking shall be carried out in accordance with any minimum testing frequencies and minimum test numbers specified in Clause 5.5.

10.1.2 Pavement Material

Each lot of constructed pavement shall be cross-referenced to the accepted lot in the stockpile from which the pavement material was obtained.

10.1.3 Moisture Content of the Pavement

The insitu moisture content shall represent the full depth of the layer and shall be measured in accordance with Test Method Q102A, or one of the subsidiary Test Methods Q102B, Q102C, Q102D or Q102E for which a relationship with Test Method Q102A has been established and used in accordance with Test Method Q010.

Test Method Q141A may be used subject to the prior approval of the Administrator. In all cases where Test Method Q141A has been approved for use, at least one test for each lot shall be undertaken in accordance with Test Method Q102A and shall be used as a calibration check. The data from the calibration check shall be analysed in accordance with "Test Method N02 Material Moisture Bias" of the department's Nuclear Gauge Testing Manual.

10.2 Product Requirements

10.2.1 General

Compliance testing of the pavement shall be undertaken for each lot.

10.2.2 Testing Frequencies and Number of Tests

The Contractor is responsible for performing sufficient tests to ensure that the pavement complies with the standards and requirements of this standard. However, the Contractor's testing program shall be such that the testing frequencies and number of tests are not less than those specified in Clause 5.5.

10.2.3 Geometrics

The geometric tolerances, except for surface evenness, shall be checked at regular intervals not greater than those specified in Clause 5.4.

10.2.4 Compaction

The compaction standard for each lot shall be represented by the characteristic value of RDD.

The characteristic value shall be calculated as stated in Clause 12 of MRTS01 *Introduction to Technical Standards* using the individual RDD determined from each lot.

The location of each insitu dry density test shall be chosen by a method of random stratified sampling as given in Test Method Q050.

The insitu dry density shall be determined by Test Method Q141B or Q141A and the maximum dry density of a reference sample shall be determined by Test Method Q142A or Q144A.

10.2.5 Segregation

There shall be no visible signs of segregation on each lot.

Samples shall be taken from each lot to check that segregation of the material in the lot has not occurred. Additional samples shall be taken from any areas which show visible signs of segregation. Each sample shall be tested in accordance with Test Method Q103A.

10.2.6 Degree of Saturation

The degree of saturation for each lot shall be represented by the characteristic value of the degree of saturation of the individual samples taken from the lot. The characteristic value shall be calculated as stated in Clause 12 of MRTS01 *Introduction to Technical Standards*.

The degree of saturation test shall be performed within a period of 6 hours prior to the placement of the next pavement layer or the surfacing.

The degree of saturation shall be determined in accordance with Test Method Q146.

10.2.7 Surface Evenness

The surface evenness of the final unbound pavement layer shall be measured by road roughness (Test Methods Q708A, Q708B, Q708C, and Q708D).

The minimum length of a lot for this test shall be 100 metres and the maximum length of a lot shall be 500 metres.

10.2.8 Visible Deflection of Pavement Layers

The objective visible deflection test specified in this Clause shall apply to lots in the final pavement layer only, unless stated otherwise in Clause 8 of Annexure MRTS05.1.

Where the surface of any section of the pavement layer displays visible deflection as a result of the movement across the surface of a vehicle with a gross vehicle mass of 20 tonnes, the Administrator may require the Contractor to carry out additional compliance testing to ensure that the affected section of the pavement layer complies with Clauses 10.2.4, 10.2.5 and 10.2.6. No additional payment will be made by the Principal for such additional testing.

10.2.9 Acceptance

No layer of a pavement shall be covered by a subsequent layer of pavement or by surfacing until all testing has been completed and the layer has been presented to the Administrator for permission to proceed.

Hold Point 5

11 SUPPLEMENTARY REQUIREMENTS

The requirements of MRTS05 *Unbound Pavements* are varied by the supplementary requirements given in Clause 13 of Annexure MRTS05.1.